Job Loss Analysis – Heater Survey

Control No: 2000216 **Status:** Closed **Original Date:** 1/1/2011

Last Date Closed:

Organization: Global Manufacturing

JLA Type: Global Manufacturing Shared

Work Type: Technical Process Engineering

Work Activity: Process Engineering Heater Survey

Personal Protective Equipment (PPE)

☐ Goggles	☐ Hearing Protection	☐ H_2S Warning Device	☐ Gloves(leather)
☐ Face Shields	☐ Hard Hat	☐ Tagout/Lockout kit	☐ Other
☐ Safety Glasses	☐ Safety Shoes	☐ Hi Viz Jacket	☐ Other
☐ Safety Black Belt	☐ Safety Cones	☐ Welding Hood	☐ Other

Reviewers

Reviewer Name	Position	Date Approved
Charles Odumah	Process Engineer	5/2011
Michelle Johansen	Process Engineering Manager and Global PED JLA Development Team Leader	6/23/11

Development Team

Development Team Member Name	Primary Contact	Position
Martin Arthur		Process Engineer
Andy Redman		Lead Process Engineer
Ed Shepherd		Furnace BIN Leader

Job Steps

No.	Job Steps	Potential Hazard	Critical Actions
1	**PRE WORK** Ensure portable flue gas analyzer is charged and calibrated. Ensure portable draft gauge (-0.3 to +0.3 psig) is available.	1. Inaccurate analyzer could invalidate survey.	1. See analyzer tech for calibration gases.
2	Check DCS trends of feed rate, O_2, CO, Draft, stack damper position, arch temp, stack temp, fuel gas rate, fuel gas BTU value, etc.	1. Avoid doing survey during unstable or upset conditions.	1a) Understand where heater is running during survey compared to normal rates. 1b) Validate DCS readings with field data where applicable.
3.	Familiarize yourself with the burners to be surveyed.	1. Flame patterns need to be appropriate for the burner type.	1. Locate and review burner drawings.
4.	Have available design data for the heater.	1. Unrecognized operational deviations may cause risk.	1. Locate and review Fired Heater Design Data Sheet.
5.	**START OF SURVEY** Check into plant with operations. (Request hot work permit if required.)	1. Operating changes may cause risk to personnel who are in plants without operator knowledge.	1. Operations must be aware of your location and planned work.
6.	If applicable, review hot work permit conditions before starting furnace survey.	1. Deviation from procedures is a violation of Tenet #4.	1. Observe all procedures.
7.	Check location of instruments: Draft for DCS should be measured below the convection section. Observe and record location of O2 analyzer tap.	1a) Incorrect draft data could cause the furnace to be operated with positive internal pressure. 1b) Misinterpretation of O2 data could result in insufficient combustion air at the burners.	1. Location of O2 reading affects interpretation of values. (Understand that O2 readings taken in stack include leakage air from the convection section.)
8.	Check draft reading at local field gage before opening sight ports.	1. Positive firebox pressure can result in hot flue gases coming out of firebox.	1. Ensure field draft reading agrees with DCS draft reading.
9.	Open firing platform sight port and verify that firebox pressure is negative. If firebox pressure is positive, have operations address the problem before proceeding.	1. Personal hazard: Positive firebox pressure can result in hot flue gases coming out of firebox.	1. When opening the sight port, stand off to one side and check the draft inside the furnace by placing an empty glove near the port opening. If the glove is pushed away from the port it indicates positive pressure. If the glove is drawn toward the port it indicates negative pressure.
10.	Observe flame patterns. Check from all accessible sight ports.	1. Flame impingement on tubes can cause hot spots, coking, and, in extreme cases, tube ruptures.	1a) Identify and record any burners with poor flame patterns. 1b) Look for signs of burner tip plugging.
11.	Inspect the firebox for the following: 1. Hot spots on tubes	1. Hot spots on tubes can lead to tube leaks or ruptures.	1a) Perform an internal inspection of the furnace firebox through all sight ports to look for

No.	Job Steps	Potential Hazard	Critical Actions
	2. Sagging tubes 3. Tube off of supports 4. Broken tubes supports 5. Damaged insulation 6. Dark spots on insulation indicating ambient air leaks 7. Damaged burner tiles		abnormalities. 1b) Inform operators of any immediate concerns that are observed.
12.	Check consistency of burner air register settings.	1. Uneven air registers lead to uneven firing. Personal hazards: Gas leaks at unions, hot steam tracing, hot condensate drips.	1. Each burner should be getting the same amount of fuel and air.
13.	If applicable, check pilot air doors (air registers).	1. Closed air door on pilots will affect pilot flame stability.	1. Identify pilot air doors and check for uniformity of settings.
14.	Find access points above and below the convection section to take the following readings: 1. Draft 2. O2 3. CO and/or Combustible 4. NOx 5. Temperature	1. Personal hazards: Be cautious withdrawing hot probes.	1a) Take readings in more than one location at the same elevation on large furnaces. 1b) Record value, time, and location for later comparison with DCS values.
15.	Inspect for potential tramp air leaks at the following locations: 1. Process tube penetrations (radiant and convection sections) 2. Header box covers (radiant and convection sections) 3. Tube skin TI casing penetrations. 4. Air registers of offline burners 5. Other	1. Air leaks quench flue gas which leads to poor heat transfer, reduced efficiency, higher firing rate, and higher NOx.	1. Air leaks can be detected with a hand-held magnahelic gage connected with flexible tubing to a 3-foot long ¼" diameter SS tube. Air currents across the tip of the tube will deflect the needle on the gage, indicating an air leak.
16.	Inspect outside casing of furnace for hot spots due to internal insulation damage.	1. Hot external casing can be a personnel hazard and can cause oxidation thinning of the casing.	1. Discolored paint indicates a hot spot. Request an external IR scan if paint is completely gone.
17.	Check stack damper local position indicator.	1. Discrepancy between DSC reading and actual damper position could cause mis-operation.	1. Record for comparison with DSC value.
18.	If applicable, check that steam tracing is operational on fuel gas, pilot gas, and off-gas lines.	1. When steam tracing is required, non-operation can lead to liquids in fuel and burner tip plugging.	1. Check that steam traps are hot, indicating that they are working.
19.	Check out of plant with operations. (Sign off permit, if applicable.)	1. Deviation from procedures is a violation of Tenet #4.	1. Observe all procedures.
20.	**REPORT ON SURVEY** Prepare a report which includes the following: 1. Summary of field observations 2. Summary of DCS readings 3. Summary of calculated		1. Calculate efficiency as a function of stack temp and O2. 2. Calculate firing rate from fuel flow and fuel BTU value. 3. Estimate convection section duty from process flow rate and inlet and outlet temperatures.

No.	Job Steps	Potential Hazard	Critical Actions
	assessments 4. Recommendations for improvements and/or maintenance: a. Mechanical b. Instrumentation c. Combustion d. Process e. Other optimization		4. Compare design data sheet values to current: a. firing rate b. efficiency c. arch and stack temperatures d. convection section duty

HEATER SURVEY SHEET: PAGE 1 - READINGS

Heater:	Date:

Description	Value	Time	Comments
Below convection section Location 1:			
Draft (“ H2O)			
O2 (%)			
CO/Combustibles (ppm)			
NOx (ppm))			
Temp (F)			
Below convection section Location 2:			
Draft (“ H2O)			
O2 (%)			
CO/Combustibles (ppm)			
NOx (ppm))			
Temp (F)			
Above convection section Location 1:			
Draft (“ H2O)			
O2 (%)			
CO/Combustibles (ppm)			
NOx (ppm))			
Temp (F)			
Above convection section Location 2:			
Draft (“ H2O)			
O2 (%)			
CO/Combustibles (ppm)			
NOx (ppm))			
Temp (F)			
Local Indications:			
Draft (“ H2O)			
Stack Damper Position (% open)			

HEATER SURVEY SHEET: PAGE 2 - NOTES

Item	No./ Location	Notes
Internal Observations:		
Flame patterns		
Burner tip plugging		
Tube hot spots		
Sagging tubes		
Tubes off of tube supports		
Broken tube supports		
Damaged insulation		
Dark insulation (i.e., air leaks)		
Damaged burner tiles		
External observations:		
Air Leaks		
Casing hot spots		
Steam Tracing (if applicable)		
Other		